Some of my first slides I find useful to this day, and every day adds experience, or a word from some friend working in the same field. The difficulty of making sections is a myth.

Cambridge, Mass., Oct. 31. AUG. F. FOERSTE.

Search for Gems and Precious Stones.

IN reference to the interesting article of Prof. P. L. Simmonds on the search for gems and precious stones, read before the Society of Arts of England recently, reprinted in your issue of Oct. 14, allow me to suggest a few corrections. Professor Simmonds estimates the yield of the Brazilian diamond-mines at £800,000 annually, while a little later on he says that the yield has dwindled to 24,000 carats, which, at the outside will not yield more than £2 to £3 a carat, and that of India, Borneo, and Australia at £200,000, when these latter figures would probably cover the annual product of Brazil as well as that of the other three countries named. Australia produces so very little as scarcely to be a factor in the computation. Even before the opening of the African mines, in 1867, the estimated value of the product of Brazil from 1861 to 1867 was only £1,888,000, or something over £300,000 per annum, at a time when Brazilian diamonds commanded a higher price than at present, and now they produce much less. His statement that the opal is out of fashion would have been true several years ago, but is not to-day, when more of these stones are sold, and at better prices, than ever before.

The carat is given as 3.174 grains; whereas, since there are 151.5 English diamond carats in an English Troy ounce of 480 grains, an English carat would be 3.1683168 Troy grains, or, less exact, 3.168. A diamond carat is always divided into four diamond grains equalling .792074 of a Troy grain. If 31.103 grams equal an English Troy ounce, a carat would be .205304 of a gram.

An international syndicate composed of London, Paris, and Amsterdam jewellers, wishing to establish a uniform carat, in 1877 confirmed .205, however, as the true value of a carat, in which case we have 151.76 carats in an ounce Troy.

These may seem trifling differences, but yet they are enough to affect a $10,000 lot of diamonds, worth $100 a carat, to the amount of $4.83 between the 3.174 carat and the 3.168 carat, and $19.80 between the former and the syndicate carat.

It would perhaps have been better to make the reference to imperial jade, which he mentions several times, under the head of the jade-quarries of Burma, as this (*Feitsui*) imperial jade is jadeite, not jade, and is generally only emerald green in spots or streaks, the mass being a dead white, lending a vividness to the green which occasionally almost rivals the emerald, and has the hardness of 7.

Of the articles of jade shown by the New Zealand Court at the colonial exhibition, England, Professor Simmonds says, "Evidencing the skill of the Maoris in working this hard material, the second in this respect to the diamond, although much more fragile," etc. This would lead one to infer that the material possesses great hardness, when, in fact, the hardness of jade is only 6.5, less even than that of rock crystal, and it can be worked with sand, by which laborious means, undoubtedly, all of the aboriginal ornaments of the Maori were made. So far as its fragility is concerned, it is the toughest of all known minerals, and this is the reason why it is so difficult to work. It would require less time to polish twenty surfaces of agate, which is harder than jade, than it would to polish one of jade on the same wheel. Krantz, the mineral-dealer of Bonn, having a fifty-pound piece of jade which he wished broken into small hand specimens, a friend kindly offered him the use of a large half-ton trip hammer to break it with. At the first blow the hammer was demolished, and the jade was only fractured by being heated and thrown into cold water.

We frequently hear minerals or gems loosely spoken of as second or third in hardness to the diamond. On the Mohs scale of hardness, the diamond is represented by 10, the sapphire by 9, topaz 8, and quartz 7; but, although the difference on the scale is only 1, there is room for several substances between the diamond and the sapphire; and, as we have no such known substance in nature, we place diamond on 10. In reality, so great is the difference between these two substances, that, if the hardness of the sapphire is 9, that of the diamond would be fully 100, relatively to the rest of the scale. Professor Simmonds also says that coral has the hardness and brilliancy of agate. Quartz and agate are placed at 7 in the Mohs scale, whereas coral has only the hardness of about 3, the same as that of marble (calcite), and can be scratched by fluorite. It is impossible to see how this opaque substance can be said to "shine like a garnet, with the tint of the ruby."

A word, in closing, about the hardness of agate and rock crystal. Mineralogically these are classed together at 7; but in reality the crystalline varieties should be 7, and the crypto-crystalline varieties 7.3, since they will readily scratch quartz, and quartz will not scratch them. GEORGE F. KUNZ.

New York, Oct. 31.

Living Lights.

WE have noticed in your journal (*Science*, x. No. 246) a review of the book on phosphorescence called 'Living Lights.' The writer, it seems, must have made a very hasty perusal to have failed to see that the statements therein are not conjectural, but in each case are from individuals we are accustomed to honor as credible witnesses.

The fact of this review being in the columns of a science journal is, of course, the only reason for our interest in it. The most charitable construction which we can put on this surprising exhibition of lack of knowledge is that the reviewer did not notice the array of great names which support the statements of the book, for we cannot think that any one would knowingly dispute the words of such men — and naturalists.

The reviewer starts off by throwing discredit and ridicule on the entire world of luminosity, seemingly denying that attribute to all living objects. He says, "Not only do fire-flies fly, glow-worms glow, zoöphytes twinkle in the sea, but sea-anemones, alcyonarians, gorgonias, star-fishes, earth-worms, crabs, shell-fish, lizards, frogs, toads, fishes, birds, monkeys, and men must be added," etc.

We confess to embarrassment in approaching the task of replying to such, for one is impressed with the notion that some occult jest is intended; but again we are reminded of the character of the journal, and a feeling of surprise follows at the incomprehensible lack of knowledge displayed regarding the subject in hand.

The reviewer continues, "There is no excuse for conjectural illustrations, and ideal views of possible appearances." Shall we inform him that twelve of the plates in 'Living Lights' are process copies taken from lately published bulletins of M. Filhol, M. Dubois, and from sketches of the deep-water dredged objects obtained by the gentlemen of the 'Challenger,' 'Travaileur,' 'Porcupine,' 'Majenta,' and others, several of whom kindly furnished the author with advanced papers for use in his work?

Thus for twelve of the illustrations: for the remaining ones, it were absurd indeed to defend them. The former, as being matter not yet widely extant, some of it not published outside of society bulletins, may well be regarded as unfamiliar. The quotation which the reviewer takes from the book is treated so as to mislead. The author evidently meant to convey that it is difficult to represent the phenomenon of luminosity in marine animals, as their integrity is injured on exposure to air, though no question is entertained of their luminosity. A kindly review of this portion would rather praise the caution exhibited by the author in stating that the pictures may possibly not exactly portray the real appearance as it exists in the sea. The statements of the reviewer are so sweeping and (possibly) damaging among those not informed, it would seem advisable to state facts, though it is a humiliating thought that the brilliant work of so many eminent men should in such quarters be unknown.

It is but justice to do this, as the author of 'Living Lights' is at present beyond reach, at a distance from home, and of course unable to reply seasonably.

The statement, "zoöphytes twinkling in the sea" might well have covered the ground for one group, without enumerating "sea-anemones, alcyonarians, gorgonias," etc., also; but this enumeration will serve to suggest what objects concern us, as those arraigned for false attributes. We presume that few will deny the luminous gift to fire-flies, glow-worms, etc., which are mentioned in this connection. Let us, then, pass to the sea-anemone record. Colonel Pike of Brooklyn, an American naturalist not to be questioned, has given at length his testimony, and we know that the author himself has an experience as to their luminosity, which,

coupled with that of Van Benedin and numerous other European zoölogists, we assume is weight enough to give respectability.

The luminosity of gorgonias, sea-worms, star-fishes, etc., is a well-known fact to us from long residence on the Florida reefs; but, should it be desirable to fortify such evidence, we would refer to testimony of Sir Wyville Thompson, and several other successful dredgers.

It would have saved somewhat of the task of this *exposé*, had the reviewer read the history of the *Brisinga*, the luminous star-fish, which 'Living Lights' gives amply, and illustrates by process picture from the original, through courtesy of M. Filhol and M. Dubois, the latter having had some of the dredgings of the 'Talisman' for examination. The work of Charles Abjordsen of Norway, on the luminosity of this creature, is also extant, who pleasantly named it *Gloria maris*. M. Quatrefages may also be called to testify, if need be, whose valuable work on the luminosity of the star-fishes is well known. P. Martin Duncan and some others are remembered in this connection.

The crustaceans are next summoned to show cause. Must we arraign our own Verrill and Smith? Shall the ancient Viviani be questioned? May we lightly dispute the words of Nordenskiöld, Giglioli, Sir Joseph Banks, MM. Eydoux and Souleyet, Norman, Vaughn, Thompson, Murray, V. Willemoes Suhm, and a host of others whose descriptions of the luminosity of crustaceans are not in sober earnest to be called "displays of pyrotechnical natural history"? The attractive picture of *Colossendeis*, copied from M. Filhol's delightful work, is one with others which the reviewer chooses to designate as "conjectural illustrations" and "ideal view for which there is no excuse."

Regarding fishes, Dr. Gunther's views and statements are considered good science. His kindly correspondence with the author pleasantly confirms all that he has written on phosphorescence of fishes.

M. Carlo Emery, of the Italian Zoölogical Schools, kindly communicated his experiments to the author, with drawings, on the luminosity of the insect *Lucciola italica*. It were better due this eminent naturalist in the pages of an American science journal to acknowledge his original investigations in the spirit of science, rather than pronounce them examples of "pyrotechnical natural history," etc.

It certainly cannot be necessary to go further; but as the picture of a heron was particularly mentioned as "distinctly misleading," etc., it may be well to direct attention to the facts in the case. Attention to the text will show that the author carefully and at much trouble set about gaining, if possible, any additional knowledge concerning the alleged luminosity of the breast of the night-heron. It has long been a widely known belief among hunters that the powder-down patches on the heron's breast are at times luminous. We have learned from very many ornithologists that the belief was familiar to themselves, and in general there is an inclination to consider it true. The editor of 'Living Lights' received some remarkable confirmations of the long-existing say-so, and in his book plainly exhibits several of the most convincing, — no less than positive statements in answer to categorical inquiries by the author.

It chanced that we were able to ask the opinion of the eminent English naturalist, Mr. Alfred Russell Wallace, to whom this subject was familiar. He expressed readiness to believe the existence of luminosity in such birds, notwithstanding the literature on the subject is so meagre, and quoted the well-known case of the lantern-fly. Mr. Wallace was an explorer in South America, as is well known, and in answer to our question he said, "I did not observe the phenomenon of luminosity in the lantern-fly, but Madam Mérian, the distinguished entomologist, and the Marquis Spinola, did; the former giving detailed accounts of several which emitted such powerful luminosity, on opening the box in which they were confined, that she was alarmed. I am therefore not entitled to deny the statements."

Regarding the higher animals and man, as in relation to the phenomenon of luminosity, the long-recorded example of the brilliant eyes of the South American monkey should be regarded; and if the statements concerning man, as published by Dr. Phipson in his nearly unique treatise on this subject, as quoted by the author, are not entitled to respect, and protection from the assertion that such "statements are distinctly misleading and wrong . . . and highly colored, and admitted on very slender evidence," then we have no remedy.

In a few words, the considerable fresh material in 'Living Lights' should have received favorable notice; for, added to the large amount of facts in marine zoölogy long familiar to the author through actual personal contact with marine life on all parts of our coast, on the extreme northern and on the Florida shores, and on the two oceans, here is presented noticeable examples of luminosity in every grand division of zoölogy, and in the vegetable and mineral worlds, all furnished by the eminent zoölogists, with accompanying figures, which the reviewer has chosen to ignore or ridicule.

The amount of information and data obtained by the author through the United States Fishery Commission is very great, and it is due to the memory of the late lamented commissioner to say that the work of the 'Albatross' and 'Fish Hawk' exceeds all others in the contributions to science derived from the deep-sea dredgings. The history of luminous marine animals, judged by those acquainted with marine zoölogy, is by no means exhausted.

A.

New York, Oct. 26.

Sorghum-Sugar.

IN an article under the above caption published in *Science* about a year ago (viii. p. 361), I ventured to make the following prediction with reference to the experiments which were being carried on in Kansas under the direction of the United States Department of Agriculture: —

"The indications from the present results are most hopeful, — that, with the expenditure of a small fraction of the money and brains that have been required to develop the sugar of the beet, the sorghum-sugar industry will take a leading place among American industries, and enable Uncle Sam to accomplish a long-cherished hope, viz., of making his own sweets."

The results of this season's work, while it is not yet fully completed, would seem to show that this prediction is in a fair way to be fully confirmed within a very few years, for a great advance has already been made towards the solution of the problem of the profitable production of sugar from sorghum.

The final outcome of last year's work was extremely discouraging to many friends of the industry, and it was only by strenuous efforts on the part of the few who still retained their faith, that the necessary appropriation for the continuation of the experiments could be obtained from Congress. Many thought that the question would be definitely settled by the experiments last year, and, as the results achieved were chiefly of a negative character, they considered that it was proved a failure. Perhaps too much was expected to be accomplished in so short a time. It has often been the case with great undertakings, and in the accomplishment of scientific problems, that their prospect looked darkest just before the dawn of their success. Such has been the case with sorghum-sugar. Negative results frequently contribute greatly toward ultimate success, and the lessons taught by some of last year's failures have been turned to very valuable account in this year's work.

The two difficulties mentioned in the article referred to as encountered in last season's work — viz., the cleaning of the chips, and the treatment of the juice — have been successfully grappled with. The former is accomplished by ingenious yet simple mechanical devices. The cane is fed, leaves and all, to an ordinary ensilage-cutter, which cuts it all into pieces about one and a half or two inches in length. These are carried to a height by an elevator, and thence dropped through a series of separating-fans, where the refuse, consisting of the blades and sheaths, is blown out; its separation from the sections of cane being quite complete on account of the much greater weight of the latter. The cleaned pieces of cane are then carried to a small cylindrical cutter, whose operation is very similar to that of a planing-machine, and which cuts the cane into quite small chips, or shreds. Thus the diffusion is effected upon well-cleaned cane, — a fact which doubtless contributes greatly to the purity of the juices obtained. The inversion of the juice in the cell, which is very apt to occur with sorghum on account of its large content of various vegetable acids, is controlled by the use of precipitated carbonate of lime, which is added to the contents of